CLAIMS

What is claimed is:

1. A watermark embedding method based on discrete cosine transformation (DCT) subband image characters to generate a frequency image from an original image using an 8*8-block DCT and to embed a binary watermark image into a subband image of the frequency image, the method comprising the steps of:

setting the values of a first experience parameter TH1 and a second experience parameter TH2;

obtaining the frequency image converted from the original image and a series (A1...An) of the binary watermark image;

extracting in order a 3*3 macro-block of the frequency image and read in order the numerical value An of the binary watermark image; and

analyzing the type of the numerical value being read from the binary watermark image and performing a DCT parameter setting for an embedded block, which further includes the steps of:

computing a plurality of sets of parameter combinations of the embedded block in the 3*3 macro-block and comparing the parameter combinations with the DCT parameter error of the embedded block;

adding the parameter combination with the least error and TH2 to replace a DCT parameter of the subband image position in the embedded block when the least error is less than TH1 and An is one of 1 or 0; and

subtracting TH2 from the parameter combination with the least error to replace a DCT parameter of the subband image position in the embedded block when the least error is less than TH1 and An is the other of 1 or 0.

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- 2. The method of claim 1, wherein the first experience parameter TH1 is set according to required image distortion.
- 3. The method of claim 1, wherein the second experience parameter TH2 is set according to required image robustness.
- 5 4. The method of claim 1, wherein the extraction of the 3*3 macro-block is performed from left to right (two blocks to the right at a time) and from top to bottom (two blocks down at a time).
 - 5. The method of claim 1, wherein the embedded block is the central block Block(2,2) of the 3*3 macro-block.
- 6. The method of claim 1, wherein the estimation function of the parameter combinations is selected from the group consisting of:
 - (1) $[Block(1,1)_{D(a,b)}+ Block(1,2)_{D(a,b)}+ Block(1,3)_{D(a,b)}+ Block(2,1)_{D(a,b)}+ Block(2,1)_{D(a,b)}+ Block(2,3)_{D(a,b)}+ Block(3,3)_{D(a,b)}]/8;$
 - (2) $[Block(1,1)_{D(a,b)} + Block(3,3)_{D(a,b)}]/2;$
 - (3) $[Block(1,2)_{D(a,b)} + Block(3,2)_{D(a,b)}]/2;$
- 15 (4) $[Block(2,1)_{D(a,b)} + Block(2,3)_{D(a,b)}]/2;$
 - (5) $[Block(1,3)_{D(a,b)} + Block(3,1)_{D(a,b)}]/2;$
 - (6) $[(Block(1,1)_{D(a,b)} + Block(1,2)_{D(a,b)} + Block(1,3)_{D(a,b)})/3 + (Block(3,1)_{D(a,b)} + Block(3,2)_{D(a,b)} + Block(3,3)_{D(a,b)})/3]/2;$ and
- (7) $[(Block(1,1)_{D(a,b)} + Block(2,1)_{D(a,b)} + Block(3,1)_{D(a,b)})/3 + (Block(1,3)_{D(a,b)} + Block(2,3)_{D(a,b)} + Block(3,3)_{D(a,b)})/3]/2;$

where Block(1,1), Block(1,2), Block(1,3), Block(2,1), Block(2,3), Block(3,1), Block(3,2), and Block(3,3) represent the 3*3 macro-blocks from left-top to right-bottom,

and D(a,b) is the DCT parameter of the subband image located at the position (a,b).

- 7. The method of claim 6, wherein a=3 and b=2.
- 8. The method of claim 6, wherein the subband image position is changed to a=3 and b=3 if the least error of a=3 and b=2 is greater than the first experience parameter TH1.
- 9. The method of claim 1, wherein adjacent 3*3 macro-blocks allow overlap 1*3 blocks on top/bottom or 3*1 blocks on left/right.
 - 10. A watermark embedding method based on DCT subband image characters to generate a frequency image from an original image using a p*p block DCT and to embed a binary watermark image in a subband image of the frequency image, the method comprising the steps of:
- setting the values of a first experience parameter TH1 and a second experience parameter TH2;

obtaining the frequency image converted from the original image and a series (A1...An) of the binary watermark image;

extracting in order a q*q macro-block of the frequency image and read in order the numerical value An of the binary watermark image; and

analyzing the type of the numerical value being read and performing a DCT parameter setting for an embedded block, which further includes the steps of:

computing a plurality of sets of parameter combinations of the embedded block in the q*q macro-block and comparing the parameter combinations with the DCT parameter error of the embedded block;

adding the parameter combination with the least error and TH2 to replace a DCT parameter of the subband image position in the embedded block when the least error is less than TH1 and An is one of 1 or 0; and

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subtracting TH2 from the parameter combination with the least error to replace a DCT parameter of the subband image position in the embedded block when the least error is less than TH1 and An is the other of 1 or 0.

- 11. The method of claim 10, wherein the first experience parameter TH1 is set according to required image distortion.
 - 12. The method of claim 10, wherein the second experience parameter TH2 is set according to required image robustness.
 - 13. The method of claim 10, wherein the extraction of the q*q macro-block is performed from left to right (two blocks to the right at a time) and from top to bottom (two blocks down at a time).
 - 14. The method of claim 10, wherein the embedded block is an arbitrary block Block(i,j) of the q*q macro-block.
 - 15. The method of claim 10, wherein adjacent q*q macro-blocks allow overlap 1*q blocks on top/bottom or q*1 blocks on left/right.

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